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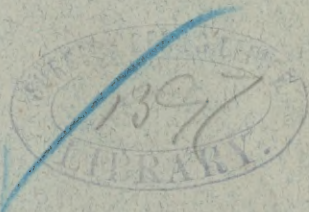
SANITARY PROBLEMS OF CHICAGO,

PAST AND PRESENT.

97

BY

J. H. RAUCH, M. D.
CHICAGO.



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THE SANITARY PROBLEMS OF CHICAGO, PAST AND PRESENT.

AN INTRODUCTORY DISCOURSE, CHICAGO, SEPTEMBER 25, 1877.

By J. H. RAUCH, M. D.,

President of the Association.

It is interesting to notice how little the elements of mere beauty of location, or healthfulness of surroundings, as things worthy to be considered, enter into the locating of towns which, in the usual growth of business and population, become large cities. Facilities for primitive trade and barter are the elements which generally first determine the sites of future cities. Careful selection of a site with reference to the wants of a large population from the necessities of the case cannot be made, and in many instances where it was supposed all the conditions obtained, failures have occurred. The sanitary problems that subsequently arise unite the necessity of accepting its deficiencies in regard to water supply, to soil, to atmosphere, to location and topography, with that of applying such artificial remedies and modifications as may be appropriate and practicable.

Marsh, in his work on "Man and Nature," says, "The influence of man in changing the climate and the physical condition of a country needs no argument to substantiate it." Withdraw man, and you remove the disturber of all laws. People must be "awakened to the necessity of restoring the disturbed harmonies of nature, where well-balanced influences are so propitious to all her organic offspring; of repaying to our great mother the debt which the prodigality and thriftlessness of former generations have imposed upon their successors, thus fulfilling the command of religion and of practical wisdom, to use this world as not abusing it." He further says, "I am satisfied that we can become the architects of our own abiding place, as it is well known how the mode of our physical, moral, and intellectual being is affected by the character of the home Providence has appointed, and we have fashioned for our own material habitation."

Such is undoubtedly the case, and it becomes our duty as far as possible to restore this harmony which is destroyed by the accumulation of human beings. The collection of many people in a small space, no matter for what purpose, is unnatural and artificial; and it is therefore necessary, in order to prevent the ill effects of such accumulations, to resort to artificial means of neutralizing the disturbing agencies.

THE NATURAL CONDITIONS. — THE LOCATION AND TOPOGRAPHY OF CHICAGO.

Up to the date when this town (Chicago) was laid out, in 1833, the territory now comprised in the limits of the city and its surroundings was occupied chiefly by the Indians. The Jesuit missionaries Marquette and Joliet were attracted to the settlement at the mouth of "the creek," upon the shores of Lake Michigan, the future site of Chicago. Later we find a trading post for barter and traffic between the Indians and venturesome and ambitious white men, who were willing to be pioneers upon the frontiers of the country, and in advance of civilization and of the government. Soon there was established a military post for the protection of the early settlers ; and, indeed, it is not very many years since the last log-building, composing a part of old Fort Dearborn, and located near the present Rush Street Bridge, was torn down. The fact, too, that during certain seasons of the year communication could be had in early days from Chicago, by means of boats and canoes, with the Indian villages along the Des Plaines and Illinois rivers, and thence with the settlements along the Mississippi River, was an additional feature which contributed to determine the site of the future metropolis of the Northwest.

When this territory was first settled nearly the whole "divide" between the waters of the St. Lawrence and the Mississippi was frequently covered by water. Until a recent date, freshets and overflowing of large areas of territory adjacent and tributary to the early town of Chicago were of very common occurrence.

This condition of the surrounding country can be better appreciated by bearing in mind that the original site of Chicago¹ was upon land lying flat and low, a level and, comparatively speaking, treeless plain, much of it marshy, and with but slight dip towards either the sluggish river or the neighboring lake. Indeed, the highest point above the level of Lake Michigan, for fifteen miles north, is only 38 feet, and southeast, for the same distance, only 23 feet.

Directly south of the city, the surface is almost level, as the highest point in sixteen miles is only 22 feet. The topography southwest is still more remarkable, as for ten miles the highest point above the level of the lake is only 10 feet at the Summit, where the waters of the St. Lawrence run northeast, and those of the Mississippi southwest. From the Summit there is a gradual descent, until the ground is lower than the surface of the lake. At twenty miles, it is only one foot above the lake.

Three miles directly west, the surface is 17 feet ; five miles, 20 feet ; and seven miles, 27 feet. At Austin, where no doubt was once the shore of the lake, and continuing two and a half miles further, to Harlem, we find an elevation of 48 feet, the highest point in any direction within ten miles of Chicago. Thence to the Des Plaines there is a descent, the bottom of the river being 26 feet ; there is then a marked increase in the ascent,

¹ Chicago is situated in latitude 41° 52', longitude 78° 35', and is 591 feet above the level of the sea.

so that at fifteen miles the surface is 102, and at twenty 125, feet above the level of the lake. Northwest of the city, at four miles, we find an elevation of only 10 feet; at seven miles, of 27 feet, where we again strike the original lake shore; at ten miles, 40 feet; at eleven miles, 65 feet; at twelve miles, 82 feet; from this point there is a gradual descent to the Des Plaines River, where the elevation is 33 feet; thence the ascent is gradual, and at twenty miles it is 96 feet.

It will be seen from the foregoing that the highest point within five miles from the mouth of the Chicago River, in any direction, is only 23 feet, and for ten miles 48 feet, above the level of the lake; and that a large portion of this ground was originally low and swampy, with but little surface drainage and an average elevation of about 12 feet only.

As a necessary consequence, as in all plains, great and sudden changes of moisture and temperature take place. So far as regarded its sanitary and topographical features, such was the natural condition when Chicago was located. The winds, meeting with no obstructions, had full sweep. The only interruption to the winds in this open plain might be said to be the narrow belt of timber on the Des Plaines River, with here and there an occasional patch of thinly covered woodland on the elevations which once were the shores of the lake. With these exceptions, the open plain is continuous for a great distance northwest, west, and southwest. It is true, timber is scattered north and south, but, unfortunately, there is not enough to materially influence the climate, in addition to the fact that the winds are rarely from either of these directions.

In an area of four hundred square miles surrounding Chicago, there were only about twenty-five square miles which were thinly covered with timber: ten of these were found on the north side of the city, and along the north branch of the Chicago River; five south and southeast; and ten on the ridges six miles west, and in the valley of the Des Plaines River.

THE GEOLOGY OF THE SITE OF THE CITY.

The geological structure of the region embracing Chicago and the surrounding country is exceedingly simple.

The underlying rock is the Niagara limestone, which has a general dip N. N. E., and consequently sinks deeper as traced lakeward.

Upon this floor was originally deposited a mass of blue clay, not less than 100 feet in thickness; but as traced towards the former rim of the lake, it rapidly thins out.

This rim is clearly defined in one or more terraces, which are traceable from the head of the lake far into Indiana. To the west of the city, however, eight and a half miles distant, at Harlem, they constitute the "divide" between the waters of Lake Michigan and the Mississippi.

While the lake has receded far below its former level, it has left behind a series of sand ridges, the intervals between which were occupied by ponds, which, by reason of the sluggish flow of the water and their sheltered position, have proved favorable to the growth of the peat-producing plants, from whose decay have resulted large accumulations of humus, or vegetable matter. It is upon this ancient lake-bed that Chicago was founded.

The original surface was diversified by sand-banks, most numerous along the lake shore, extending occasionally to the depth of sixteen feet ; by partly filled lagoons, and by a vegetable mold (which covers the greater portion of the city), resting sometimes on blue clay, and sometimes on beds of sand and gravel, and occasionally mixed ; the depth of these varying with their proximity to the Chicago River and its branches. The whole region, as before remarked, was originally low, flat, and ill-drained. Some of the business blocks at the present time are built upon partly filled lagoons. In the soundings made, preparatory to the construction of the Lake Tunnel for the Water Works, it was found that the lake-bed was composed of blue clay, with superficial sands above, which shifted in heavy storms. Such a soil must necessarily exercise a decided influence upon the health of those living upon it, depending, of course, upon the question whether their houses rest upon sand, clay, or humus.

THE INFLUENCE OF LAKE MICHIGAN ON HUMAN LIFE.

Of all the local conditions that obtain at Chicago, none exercise a greater influence on the climate than Lake Michigan. It moderates the extreme cold of winter and the oppressive heat of summer ; increases the humidity of the atmosphere and the quantity of rain that falls ; and causes local currents of air, thus partially changing the prevailing winds of this latitude, producing necessarily local changes of temperature. These local undulations are most marked in the spring, owing to the fact that the specific heat of the land is only one quarter that of the water, and is both absorbed and given out more rapidly ; while water, on the other hand, absorbs it more slowly, stores up a greater quantity, and parts with it slowly, owing, no doubt, to the difference in their conducting and radiating properties. It is mainly due to this fact that our springs are so cold, raw, and long continued ; that is, the water is not as soon heated as the land, thus giving rise to local changes of temperature and of winds. In the autumn, the heat of the water is less readily abstracted than that of the land, thus causing the temperature in the immediate vicinity of the lake to be milder than even at localities further south and west. The mean temperature of the lake is no doubt the same as that of the land for the year, differing only in the absorbing and parting power of heat, as is evidenced by the fact that the freezing point obtains only a short distance from the shore. It will therefore be seen how for eight months of the year, and sometimes even for nine, the lake exercises a wholesome influence upon health, counteracting, to some extent, the great and sudden changes incident to our level and open topography, while, during the remaining months, it is injurious to health, on account of the cold and chilling effect it has, in addition to causing sudden changes. Its agency in purifying the atmosphere by absorption it is hardly necessary to dilate upon in this connection.

THE INFLUENCE OF THE WINDS.

We come now to consider the winds. They are the result of changes of temperature and the precipitation of moisture, acting as changes of density, and as the movements of bodies would act to produce currents and movements in a mass of water.

The free movement of air in summer, in certain localities, is beneficial in dissipating noxious emanations and purifying the atmosphere, while in the same locality, in the cold season, it abstracts heat, in proportion, of course, to its velocity and humidity, and thus often acts injuriously upon life. The seeds of disease are frequently wafted by winds from unhealthy localities, and thus endanger those who live quite remote from the local cause itself.

Fevers and acute pulmonary and inflammatory diseases do not usually manifest themselves under the influence of the same wind, although fever and certain other diseases may occur in connection with any currents which waft the air from the neighboring surfaces, where the elaboration of a morbid cause is going on.

The north wind, which is less frequent than any other, generally exercises a beneficial influence, and in winter is the mildest, with the exception of the southeast and east winds. This wind, like all others, is influenced by locality in its effects upon health.

The northeast wind of March, April, and May, is cold and moist. This wind increases pulmonary, rheumatic, and inflammatory diseases in the spring months; but during the summer months, when the heat is extreme, or in winter, when very cold, it is beneficial and salutary.

The east wind, with the exception of the north, is the least frequent, and is more common in the spring than at any other season of the year. In the winter it is warm, and when it prevails there is a diminution in the number of cases of acute inflammatory disease. The lake exercises a marked influence upon this wind and that from the northeast.

Of all the winds, none is so depressing and enervating as the southeast wind. It is oppressive to man and beast, in consequence of checking evaporation, thus raising the temperature of the body, and causing the lungs to exhale a larger amount of carbonic acid than usual, and in this way exhausting the vital energies. The topography of the country south and southeast of the city is such as to promote currents of air from this direction, and to direct them toward the city. When the weather has been intensely cold for a number of days, a change to the southeast wind will diminish the mortality, but for at least nine months in the year it is the most fatal wind that we have in Chicago. The south wind is more common than either the east or the north wind. In winter the south wind exercises a beneficial influence in moderating the extreme cold of the westerly winds, diminishing the mortality, and the same result is observable in the spring.

The prevailing wind, not alone of Chicago, but of the greater portion of the valley of the Mississippi, is the southwest wind; if long continued, it produces harshness and dryness of the skin and general malaise. It partakes of the character of the country, and of the seasons. This wind,

sweeping over a greater unbroken expanse than any other, necessarily exercises a great influence upon health, in addition to its wafting the malarious exhalations of Mud Lake and the region contiguous to the Illinois and Michigan canal over every portion of our city, and next to the southeast is the most fatal, and causes the greatest mortality. There are years in which this is the hottest wind, and again it is the coldest.

The west wind is more common than any from the direct points of the compass; is most frequent in winter, when it is the coldest and driest. The greatest mortality, when this wind prevails in winter, is by acute inflammatory diseases. In the summer its influence is marked by a great diminution in the number of deaths. It may be said to be the healthiest wind during the entire year.

The northwest wind is cold, keen, and penetrating in winter; in the spring cold, blar, and bleak; and in summer cool and refreshing. It is of about equal frequency during the winter, spring, and autumn months, being least prevalent in summer. Its injurious effects are strongly marked in winter, and particularly in the spring, when it causes great changes of temperature, resulting in pulmonary, rheumatic, neuralgic, and inflammatory affections; while in summer it diminishes the rate of mortality, and exercises a wholesome influence upon the general health.

THE TEMPERATURE.

Owing to the open and treeless plain upon which it is located, and by which it is surrounded, the consequent exposure to the winds, and the evaporation from the lake, Chicago is subject to very frequent and sudden changes of temperature. From observations made at Fort Dearborn, extending from 1832 to 1836, the annual mean temperature was 46.7° F., and from 1866 including 1876 49.5° F., which shows that the temperature is gradually becoming higher.¹ As a rule, January is the coldest month, February and December are next; while July is the hottest, and August and June are next so. The extremes of temperature are not as great here as they are farther west, and at points remote from large bodies of water. The climate may be said to be semi-continental. By way of comparison with other localities, it has been found from observations made for a series of years that the range of temperature at St. Louis is 125° F.; at Prairie du Chien, 132°; at Rock Island, 120°; Fort Snelling, 140°; Council Bluffs, 129°; Detroit, 107°; Toledo, 103°; Lansing, Mich., 107°; Mackinaw, 117°; and Chicago from 1832 to 1836, 116°, and from 1866 to 1870 inclusive, 111°. Since the latter period it has come down to 107°, showing that the climate is becoming more equable, and that the alternations of heat and cold are not as great as when the place was first settled.

THE RAIN-FALL.

The amount of rain that falls is an important factor in the healthfulness of a locality, especially in one like that of Chicago. Here, as elsewhere, there are annual fluctuations of mortality, independent of epidemics.

¹ For 1877, 50.3°; for 1878, 51.8°.

The months of July, August, and September are those in which the lack of drainage has been most marked in its influence upon human life, especially in cases of children under five years of age. The following table will show that the death-rate has tallied with the rain-fall during these months from the year 1866 to 1872 inclusive :—

YEAR.	July, inches.	Aug., inches.	Sept., inches.	Total 3 mos., inches.	Total year, inches.	Death- rate per 1,000.
1866	3.58	7.84	6.53	17.95	36.65	32.22
1867	1.51	2.32	.40	4.23	21.26	21.16
1868	3.86	3.58	7.08	14.52	37.33	23.74
1869	3.21	1.38	.89	5.48	31.66	23.16
1870	3.71	2.17	2.82	8.70	23.62	24.53
1871	2.56	.50	.10	3.16	32.85	21.46
1872	4.05	2.56	6.43	13.04	28.94	27.61

The mean annual rain-fall at Milwaukee for twenty-five years was 30.20 inches ; at Toledo for six years, 38.94 ; at Lansing for four years, 30.56 ; and at Chicago from 1866 to 1874 inclusive, 30.84 inches.

I have also observed that there were greater annual fluctuations at Chicago than at the other points mentioned, all being within the thirty-inch rain-belt. The difference is also greater in the summer. Since 1874 there has been a marked increase in the number of inches that fell at Chicago, so that for the last four years we have had 41.93 inches. Attention is called to the following table, showing the chief causes of death for the year 1872, nearly all the decedents being under five years, and showing how the rain-fall and temperature affect infantile life. Nearly one half of all the deaths during this period resulted from the six mentioned diseases.

	April.	May.	June.	July.	August.	Sept.	Total.
Cholera infantum	6	10	146	549	530	187	1,428
Convulsions	94	71	101	112	116	81	573
Diarrhæa	8	5	53	73	132	63	384
Dysentery	2	3	26	38	63	30	162
Tabes mesenterica	8	14	21	40	38	27	148
Teething	3	14	16	25	34	14	106
Total	121	117	363	837	913	402	2,801
Mean daily temperature, degrees.	48.6	57.5	70.2	72.5	72	94	
Rain-fall	2.99	3.28	3.41	4.08	2.56	6.43	

THE ARTIFICIAL CONDITIONS.

I have thus far described the natural conditions surrounding Chicago, and will now briefly call your attention to what has been done to improve its sanitary condition. The question of the water supply first attracted attention, as will be seen by the following :—

¹ In 1878, 48.84 inches fell, a greater amount than has fallen in any year since 1832, and probably than ever before.

THE WATER SUPPLY OF THE CITY.

During the prevalence of cholera in 1849 and 1850, it was observed that nearly all who drunk the water of a certain well on North La Salle Street, died. This of course attracted attention, and was supposed to be owing to the fact that the well received the drainage from privies in the neighborhood, and in this way infected those who drunk the water. This was true; but I found afterward that in this neighborhood the soil was stratified by thin layers of blue clay, which is impervious to water, and whenever these layers were penetrated by wells they acted as drains for a great area, the remaining portion of the soil being composed of sand until the thick stratum of blue clay underlying the greater portion of the city was reached. My attention was first called to this fact in the City Cemetery, while I was investigating the subject of intramural interments, in 1859. I here found in certain portions of the ground, particularly that adjoining Clark Street, and supposed to be the highest and best for burial purposes, at a depth of about two and a half feet, a stratum of blue clay about six inches thick, the overlying stratum being composed mostly of humus and of sand. The blue clay penetrated, sand was again found to the depth of five feet, the required depth of graves in this cemetery. After a heavy rain-fall, water had to be dipped out of the grave while the digging was in process. I also noticed, in a number of instances, that when the graves were finished but little water was found in them, while in the course of an hour or two they were filled to the upper edge of the blue clay. In one case, in a space where no graves had been dug before, I saw the water running through into the opening after the blue clay was cut.

The effect of drinking well-water was so marked during the prevalence of cholera in the years mentioned, compared with that of drinking lake water, which was supplied to a small number of inhabitants by the Chicago Hydraulic Company, a private enterprise, that an act was passed, on February 15, 1851, by the legislature of Illinois, incorporating the Chicago City Hydraulic Company. This was the commencement of our present magnificent system of water supply, which has grown with our needs and necessities; and it is not presumptuous to say that at this time the supply of water is as great and good as that of any large city in the world.

THE DRAINAGE OF THE CITY.

The necessity of the systematic drainage of Chicago was not fully appreciated until it had suffered from epidemics for six years in succession, five of cholera and one of dysentery; the death-rate during this period being higher than that of any other city in the United States. As the result of this terrible experience, on February 14, 1855, an act was passed by the legislature of Illinois creating the Board of Sewerage Commissioners. In compliance with the act, the commissioners were elected as prescribed, and steps immediately taken to give practical effect to the same in surveys, and in the consideration of plans for the drainage of the city. The plan proposed by E. S. Chesbrough, Esq., was adopted in December, and in 1856

the work of constructing sewers commenced. This has been mainly adhered to since, and prosecuted with varying vigor and effect, as will be seen by the following table, showing the number of feet built annually, the population, the mortality, and the death-rate per thousand :—

Sewerage.

Year.	Number of Feet of Sewer Built.	Population.	Deaths.	Death-Rate per 1,000.
1856	31,794	84,113	2,086	24.80
1857	25,681	93,000	2,414	25.66
1858	101,879	84,000	2,255	26.84
1859	55,208	96,000	2,008	21.36
1860	69,024	109,260	2,264	20.70
1861	2,826	120,000	2,279	18.99
1862	15,685	137,030	2,835	20.69
1863	39,605	150,000	3,875	25.83
1864	25,021	161,288	4,448	27.57
1865	29,948	178,492	4,029	22.57
1866	48,127	200,418	6,524	32.22
1867	89,661	225,000	4,648	21.17
1868	47,841	252,000	5,984	23.74
1869	139,705	280,000	6,488	23.16
1870	78,166	299,227	7,343	24.53
1871	50,392	325,000	6,976	21.46
1872	57,342	367,293	10,156	27.60
1873	47,342	385,000	9,557	24.82
1874	146,702	395,409	8,025	20.29
1875	222,322	405,000	7,899	19.50
1876	120,971	415,000	8,573	20.65
1877	64,666	434,000	8,026	18.24

For the purpose of more clearly showing the influence upon life of this, the most important sanitary movement ever inaugurated in this city, I would call attention to the fact that the mean annual death-rate from 1843 to 1856¹ was 37.91 per thousand, while from 1856² to 1870 it was only 23.97, and from 1870 to 1877 inclusive 22.13.³ The last period includes the effect upon life of the "great fire," and also of an epidemic of scarlet fever.

The following will more fully explain how drainage acts beneficially in this city.

I have found, in judging of the comparative healthfulness of different wards, that the soil affects health by its conformation, elevation, and mechanical structure, — conditions which influence absorption and radiation of heat, reflection of light, absorption, retention, and movement of water over and through it, in addition to the passage of air through the soil. The soil

¹ This is still more marked when it is borne in mind that up to this date there was a great excess of adults, as is always the case in a newly settled country or town.

² The year when sewer construction commenced.

³ Including 1878, the death-rate would be 21.51.

may also affect health by its chemical character, which acts especially by altering the composition of the air over, or the water running through it. In this way, in addition to its natural character, the decomposition of organic matter affects the atmosphere or the water, and this is particularly the case when houses are located upon the ground, where, owing to the influence of temperature and moisture, septic gases are generated and pent up, and thus exercise an injurious effect upon the occupants of such towns. It is therefore a matter of great importance to keep the ground under buildings as dry as possible, to prevent the formation of noxious gases, particularly where the sun and air have no direct influence.¹

In Chicago this can be accomplished only by thorough surface and sub-soil drainage.

"The heat of the sun is absorbed in different amounts by different soils equally shielded. Color and aggregation seem chiefly to determine it. Loose and incoherent sands are the hottest, while compact and clayey soils are the coldest. The absorbing and radiating powers of soils are not necessarily equal, though they may be so. Generally, the radiating power is more rapid than the absorbing, — soils cool more rapidly than they heat. Here the sandy soil is the most healthy, while the clayey soils are damp and moist, and naturally productive of certain classes of disease.

"It has also been observed that some soils absorb and retain moisture more than others. Sand absorbs and retains but little water, clays from ten to twenty times more, and humus, or common surface soil, more than fifty times as much as sand.²

"Clays sometimes contain as much as ten per cent. of water by weight, and thus are injurious to health in two ways by being moist, and, although they contain but little organic matter, the moisture aids in its decomposition, and thus they are malarious."³

In any depression into which there is drainage, no matter what the character of the soil, there is danger to health. Even sandy soil may be damp from this cause, the water rising through the loose particles from the pressure of higher levels; or, as is frequently the case in this city, there are pockets of sand into which the drainage of the surrounding soil collects; or an impervious clay is found forming a basin without an outlet, where the water collects and remains until removed by drainage or evaporation.

In July and August, 1849, cholera was epidemic in this city, and generally prevailed in low and filthy localities. This did not obtain, however, in one instance, as in three blocks, not far from where the Water Works are now located, in the locality known as the "Sands," which was high, sandy, and

¹ At one time it was customary in Chicago to build the smaller houses directly on the ground; but the custom is gradually disappearing, because the death-rate was found to be higher where the tenement was so built than where it was elevated or had a basement.

² In the winter of 1870 and 1871 I went to South America at the request of the Orinoco Mining and Exploring Company, to see whether the sanitary condition of a gold-mining district, in Venezuela, south of the Orinoco, could be improved. By carefully weighing and drying the soils I found that they contained even more moisture than is indicated in the text.

³ From my report on drainage to Chicago Board of Health, 1868.

apparently dry and salubrious, it was very severe and fatal. This locality was inhabited by 322 persons, who were chiefly Norwegians, many of whom had recently arrived.

Nearly all were attacked, and forty-four fell victims to the malady. At the time and for many years after it was queried as to the cause, since the locality was regarded as, comparatively speaking, a healthful one. It was not until 1869 that the chief factor in this high death-rate was discovered by myself. While engaged in examining the borings made in different parts of the city, I found that there was a depression or basin in this locality, in the blue clay, and, as a necessary consequence, the drainage of the neighborhood collected to the depth of two and three feet, while the drainage elsewhere found its way to the lake and the Chicago River. This basin was about seventeen feet from the surface, the overlying strata being composed of loose sand. As these people used lake-water for culinary and domestic purposes, the prevalence of the disease was regarded the more remarkable. No doubt the privies drained into this basin, and the excreta from the first cases was soon carried into it, with the foregoing result. They were living, as it were, above a hidden cesspool. The locality since sewers have been built is one of the healthiest in the city.

In July, 1873, during the prevalence of what was called cholera in the southern portion of this city, I noticed a most marked effect of drainage. The district in which the disease prevailed was densely populated by Germans, Swedes, and Poles, with a level sandy soil, and but little surface drainage. The water was obtained from shallow wells supplied with surface-water ordinarily from five to sixteen feet in depth, and to protect them from caving in, they were lined with plank. A careful inspection of the block in which the first cases occurred, satisfied Dr. Reid, the health officer, and myself, that the water supply had something to do with the malady, being satisfied that the privies and the drainage of a number of cow-stables went into the wells. Steps were immediately taken to supply the locality with lake water, and the wells were all fouled, so that the water could not be used for domestic or culinary purposes. After these precautions had been taken, no new cases occurred for three weeks.

The block fronting on the east side of Butterfield Street, north of Thirty-eighth Street, was perfectly level, and had really no surface drainage; while the block south of Thirty-eighth Street, and on the same side of the street, in population and other conditions was about the same, with the exception of a little better surface drainage, and a ditch of two feet in depth on two sides of it. The number of deaths north of the street, and where the disease first made its appearance, was eleven, and south, only two. I happened to be there on July 5, during a heavy rain-fall, and observed that the surface on the north side was covered with water, while on the south the ditch had carried it nearly all away. To my astonishment in half an hour the water had entirely disappeared on the north side, and the water in the wells had risen nearly two feet, while on the south side but little change had taken place in the depth of the water in the wells.

I had frequently been impressed with our great infantile mortality, but

having made a study of this question early in 1873, I came to the conclusion that this mortality was greater in this, than in any other large city in the United States. In judging of this question, it must, however, be borne in mind that we have a younger and more vigorous population than any other city, and that proportionately we have more children and fewer deaths of those over fifty years of age. Since 1856 there were only two years, 1866 (when cholera was epidemic) and 1870, that the number of deaths under five years was greater than all others.¹ This great infantile death-rate is most marked in the undrained districts.

In my report to the Board of Health of this city, in April, 1873, occurs the following:—

“The increase in the number of deaths in 1872 over 1871 was 3,180, a greater change than has occurred in any two years in the history of the city, no matter what the increase of population was, or whether the city was visited by cholera or any other malignant epidemic. This was the more noticeable from the fact that there was not a marked epidemic prevalent, although small-pox and cerebro-spinal meningitis existed in the city, but the number of deaths from these and similar diseases was not great enough to cause this change.

“Attention has already been called to the effect of rain-fall on life, and, after careful investigation, I can come to no other conclusion than that if our system of sewerage had been extended with the same rapidity that it was from 1866 to 1870, this great increase of mortality would not have occurred.

“Prepare tables and group data as we may, the same general facts meet us. This is the more noticeable when it is borne in mind that we know positively how many feet of sewers have been constructed, and how many deaths occurred in each ward, but we do not know with absolute certainty what the population was in each year, as in some years it was only estimated, and in 1872 obtained from the school census. With these uncertainties, and making due allowance for all errors, the result is still the same. For the first period of sewer construction ending in 1860, there were built 2.59 feet to one of the population; the next ending in 1866, there was a falling off to 2.23 feet, and from 1866 to 1870 inclusive, there was an increase to 2.67 feet, and in 1871 a decrease to 2.54, and in 1872 a still greater decrease to 2.43 feet. It will, therefore, be seen that for the last two years the population of the city has been increasing faster than the sewerage has been extended, and that this is the chief cause of the increase in the death-rate. Allowing 1,200 of the deaths for increase of population and the direct result of the fire, 655 that died of small-pox, 425 from crowding and the indirect effects of the fire, we still have an increase of 900, which, I am satisfied, was caused by the want of proper drainage.

“A comparison of the Eighteenth and Fifteenth Wards will demonstrate the truth of the position taken in regard to sewerage. The first mentioned ward has nearly three feet of sewerage to every inhabitant, while the other has but seven-eighths of a foot to each one of the population. What natural

¹ In 1878 the death-rate was lower than ever before, and this decrease is manifest in the fact that there were 1,445 more deaths of those above five years than under.

advantages there are, such as elevation, etc., are in favor of the Fifteenth Ward.

"The number of deaths for July, August, and September, of 1872, were 1 in 104 in the Eighteenth Ward, and 1 in 65 in the Fifteenth; and for the whole year, 1 in 56.70 in the Eighteenth and 1 in 27.02 in the Fifteenth. Of those under 6 years, we find in the Eighteenth Ward 1 in 14.35, while in the Fifteenth there was 1 in 7.81.

"In the Eighteenth Ward there are only 89 square yards to each inhabitant, while in the Fifteenth there are 374; but, taking an extent of territory equal to the area of the Eighteenth, from the lower and eastern portion of the Fifteenth, where the greatest mortality occurs, the difference is not so great, while the air space is still greater than in the Eighteenth Ward. The density of the population in the Eighteenth Ward has been increased since the fire, by the building of a number of houses by the Relief and Aid Society, on lots on Hawthorne Avenue and Elm Street, two and three deep on the same lot, and in a portion of the ward that is undrained. In addition, almost every portion of this ward was burned over, so that the privation, added to the depressing effects of the fire, no doubt had some influence in increasing the death-rate.

"The Eighteenth Ward, as a whole, was naturally lower than any other in the city, until sewers were constructed and the streets improved. These wards are selected for the purpose of comparison, because they are more nearly alike than any two in the city, and lie on the North Branch, directly opposite to each other. Taking all things into consideration, the Eighteenth is the poorest ward in the city. Every portion of the ground is clayey, and was originally low, and its inhabitants are nearly all of the poorer class of our foreign population, of different nationalities, as is also the case in the Fifteenth Ward, with the exception that there are more Irish in the Eighteenth than in the Fifteenth."

The report to the Board had the desired effect, for by reference to the Table on Sewerage (page 11), it will be observed that from 1873 to 1877 there was a large increase in the construction of sewers. Until this period the annual increase of sewerage did not keep pace with the annual increase of population, but during this period it really overtook it, and there was a corresponding decrease in the death-rate, and although in 1875, 1876, and 1877 we had an epidemic of scarlatina, yet the death-rate steadily decreased.

THE PUBLIC PARKS.

It was not until 1866 that the people of Chicago began to take decided steps toward creating public parks on a scale commensurate with the prospective greatness of the city. Several squares and plats of ground had been devoted to the public for breathing purposes in the original plat, when the town was first laid out, and in subsequent additions made to the city.¹ Nothing tangible, however, was really accomplished until in 1869, when, by acts of the legislature, the North, South, and West Chicago Parks were created.

¹ In 1859 I recommended that the Public Cemetery be converted into a public park. This cemetery now forms the greater portion of Lincoln Park.

The two South Parks contain about 900 acres. There are three parks on the West Side—the Douglas, the Central, and the Humboldt Parks—which contain in all 670 acres, and which are connected by boulevards nearly four miles in length. Lincoln Park contains 310 acres, and is located on the Lake Shore, in the north part of the city. All these parks will be connected by wide boulevards, which are already half built, thus encircling the city by a magnificent driveway twenty-four miles long. The parks proper and the boulevards contain nearly 2,500 acres, and when complete will make as beautiful a park system as there is in the world, and one which is the best arranged from a purely sanitary standpoint.

In the year 1868 I had the honor to be requested by the Chicago Academy of Sciences to prepare a paper on this subject. My report made to that body was entitled "Public Parks: their Effects upon the Moral, Physical, and Sanitary Condition of the Inhabitants of large Cities, with special reference to the City of Chicago," and was published the following year.

In this essay, after giving an account of the parks in all the large cities of this country and of Europe, I discussed the physiology of vegetation, and of tree-growth in their relations to climate and health. My main object was to show how by the proper location of parks and improvement, and the planting of trees, the various disadvantages of our location could be overcome by artificial means. It must be borne in mind that, on the South and West Sides especially, these parks were located on marshy grounds, which in the spring were liable to overflow, and in the summer and autumn to give off miasmatic exhalations. The improvement of these grounds necessitated their drainage, which brought the environs of the city under a healthful condition. It also afforded a place of deposit for manure and other offal that could be utilized, thus materially assisting in keeping the city proper in a good sanitary condition. Besides it stimulated and encouraged the improvement and adornment of the adjacent property to a very large extent.

Within the last ten years at least *one million* of trees have been planted in the parks, along the boulevards, on private grounds and the suburbs, within twelve miles of the City Hall.

The experience of the city of Chicago in the matter of these parks has fully verified the predictions made in the paper referred to. I said "that it is not presuming too much to say that the climate of Chicago may be materially modified, and rendered more equable, by the proper location of parks, and the planting of trees, thereby diminishing the mortality of preventable diseases, and improving the general health."

From a careful examination of the meteorological record it will be seen that the drainage of the city, and of the outside lands, and this extensive tree-planting, have already diminished the climatic extremes incident to our peculiar location. It is also quite certain, as the trees become larger and others are planted, these results will be more apparent and more beneficial to the inhabitants.

In the same paper I also said: "We, perhaps more than any other community, need all the possible safeguards against overwork to be thrown around us, and I know of no better way than by the creation of parks, that

will be an ornament to the city, and places of resort, where all may enjoy themselves in a rational and healthful manner. We need parks to induce out-door exercise, and for the pleasant influences connected with them, which are so beneficial to our overworked business men, to dyspeptics, to those afflicted with nervous diseases, and particularly to the consumptive."

I introduce these quotations simply to show that sanitary science has made sufficient progress at the present time to admit of the supreme test which science falsely so-called can never endure, — that of verification by subsequent experience; and in this connection I will venture to make one additional quotation from my report to the Chicago Board of Health, on drainage, made in 1869, in which I said: —

"From the results of drainage and other sanitary measures carried on in this city, it may be inferred that the judicious expenditure of money for sanitary purposes is a sound maxim of municipal economy, and from past experience I am satisfied that the mean annual death-rate can be reduced to 17 per 1,000 by continuing in force the present sanitary and drainage regulations, thereby making Chicago one of the healthiest cities in the world."

I have thus briefly called your attention to the natural conditions that obtained here, and also to the artificial means used to improve the same, with the results. It now becomes my pleasant duty to introduce to you my friend, E. S. Chesbrough, Esq., who will describe the sanitary engineering of the city, and to whose skill as an engineer many of the results already spoken of are due.

